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INVENTORY OF FOREST AND RANGELAND AND DETECTION OF FOREST STRESS

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16. Abstract At the forest inventory site in Atlanta, Georgia, the positional accuracy of a large number of random points was checked on both precision black-and-white and bulk color composites. Errors were systematic; the ground points were found to be on the average 300 meters south of their true position on precision data and 520 meters west of their true position on bulk data. The five ground spectrometers which furnish sensor voltages to the three DCP's have been recalibrated and 2 additional wavebands added. Also, portable power supplies which can operate the sensors and DCP's for periods up to six months have been fabricated and will be tested in late May. Vegetation biomass measurements offer a means to separate range communities when coupled with ground spectral reflectances, large-scale CIR photography, and ERTS imagery.

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Figure 2. Technical Report Standard Title Page

TITLE: Inventory of Forest and Rangeland and Detection of Forest Stress

ERTS Proposal Number 226

Black Hills Test Site (Forest Stress) 226A

Coinvestigator: Frederick P. Weber

GSFC Identification Number AG-014

Principal Investigator - Robert C. Heller

STATEMENT OF PROBLEMS:

1. We have received 14 ERTS images which cover parts or all of our test sites during this reporting period. These are more images than we received during the six months following the satellite launch. Unfortunately, on these images the ground and sometimes the trees were completely snow covered. The radiance of the scene from the snow is so high that subtle differences in radiance caused by mass foliage discoloration is obscured. As soon as the CCT's of one snow-covered scene arrive we shall attempt to locate known discolored areas on the digital tapes. Of course, no one could predict the coincidence of snowfall with clear days at the time of ERTS-1 overflights, or the loss of image radiance within the forest scene because of high contrast ratios between snow and forest, until we received the first imagery. It appears that for detection of forest stress in northern areas susceptible to heavy snowfall, wintertime imagery is not desirable. However, it may be useful for determining timber density because the snow background shows through the less dense stands.

ACCOMPLISHMENTS DURING THE REPORTING PERIOD:

1. Sixty 9- x 9-inch aerial color photographs (Aerocolor, 2445) were taken from the Forest Service aircraft over dead eucalyptus trees at a scale of 1:12,000. Thousands of trees were killed from an extended cold period in December with average temperatures of 17° F. The color photos were taken for two reasons: (1) to help the planners in the cities of Oakland and Berkeley, California, and the East Bay Regional Park District determine where the most serious injury occurred so that an action program for tree removal could be undertaken, and (2) to determine where the eucalyptus stands occurred so they could be related to ERTS imagery of the San Francisco Bay region. We have received ERTS-1 images (1165-18175, January 4, 1973, and 1183-18175, January 22, 1973) which show the condition just prior to maximum discoloration. The eucalyptus stands extend up to

one-half-mile wide by 18 miles long and should be detectable on ERTS data subsequent to February 15, 1973.

2. A data analysis plan was submitted during this reporting period to reflect changes in our original proposal. We requested supplemental ERTS data over 2 stress sites (San Francisco Bay area as discussed above and the large island of Hawaii which is the location of massive killing of ohia trees) and over an additional range site near Kremmling, Colorado. We may have to supplement this analysis plan should our training and test sites continue to be too distant for human and CCT analysis as outlined in our original proposal. This problem is discussed more fully in the forest inventory section of this report.

3. The five spectrometers and DCP's erected at the Black Hills site were removed on March 29 and brought back to Berkeley for recalibration and modification. Two more wavebands are being added to the ground spectrometers (1.55 to 1.75 μm and 10.2 to 12.5 μm) to match both ERTS-1 wavebands and some of the EREP S192 wavebands. Also, self-contained battery-powered units are being built to provide for more flexible transfer of the spectrometers to remote locations.

4. Blowups of one winter image (11 January, 1172-17130) of the Black Hills National Forest were sent to the following U. S. Forest Service managers:

a. Regional forester, Denver, Colorado
b. Supervisor, Black Hills National Forest, Custer, S. D.
c. Ranger, Nemo Ranger District, Deadwood, S. D.
d. Ranger, Spearfish Ranger District, Spearfish, S. D.

The enlargements were made from negatives (made from the positive transparencies) and were enlarged to 1:250,000. The forest managers have indicated that despite the snowy conditions the synoptic view of the entire forest will be of great assistance in their planning efforts.

WORK PLANNED FOR NEXT REPORTING PERIOD:

1. The five spectrometers will be reinstalled over our four condition classes (healthy pine, insect-infested and dying pine, pasture, and limestone outcrop) on the Black Hills test site about June 1, 1973. They will be used for the last two weeks in May to collect spectral data at our forest inventory test site near Atlanta, Georgia.

2. Selection and transfer of training and test infestations of various sizes will be plotted on USGS quadrangle maps and the UTM's

derived for subsequent computer and human analysis. As mentioned earlier, only two ERTS images of partial coverage of the Black Hills test site were received last fall. We are hopeful that we will get a springtime image without snow which will cover our site. Contrast ratios of healthy and dead pines are lower in the spring and early summer than in August and September, however.

SIGNIFICANT RESULTS: None

PUBLICATIONS: None

RECOMMENDATIONS FOR CHANGES: See data analysis plan

STANDING ORDER FORM CHANGES: None

ERTS IMAGE DESCRIPTOR FORMS: 9 submitted (5 have yet to be submitted)

DATA REQUEST FORM CHANGES: None

TITLE: Inventory of Forest and Rangeland and Detection of Forest Stress

ERTS Proposal Number 226

Atlanta Test Site (Forest Inventory) 226B

Coinvestigator: Robert C. Aldrich

GSFC Identification Number AG-014

Principal Investigator - Robert C. Heller

STATEMENT OF PROBLEMS:

1. Obtaining adequate coverage for the test site remains a major problem. Between July 25, 1972, and March 25, 1973, the Atlanta site was partially covered by 40 ERTS scenes. Of these scenes only 12 had less than 20 percent cloud cover. The remainder were distributed by cloud cover as follows:

30 percent cloud cover	15
40 percent cloud cover	2
>50 percent cloud cover	21

2. Of twelve bulk color composites ordered retrospectively we have received only 5. Of those received, only three are usable; two scenes were extremely dense and uninterpretable. Recently when an obviously overexposed color composite was returned to User Services (Goddard) for reordering, we were informed by telephone that this scene was considered appealing to the eye and this acceptable. This weakness in the system makes it very difficult for investigators to perform their data analysis. If information is suppressed by underexposure or lost due to overexposure then it is not there to be analyzed. At this point no darkroom technique can bring the information back.

3. A precision color composite for scene 1084-15440 has not been received (ordered November 8, 1972). We have been led to understand that due to technical difficulties, color composites are no longer being offered as a data product. We have not seen this in an official document.

4. Geometric errors in both the precision black-and-white imagery and bulk color composites are far too great to continue with the data analysis plan as now stated.

5. Because of personnel freezes on hiring, we have been unable to employ a much-needed computer programmer. This has caused a considerable delay in this portion of our data analysis.

ACCOMPLISHMENTS DURING THE REPORTING PERIOD:

1. Bulk 70 mm multiband images for nine different ERTS scenes were combined on an I^2S additive color viewer. The procedures followed were outlined in the last bimonthly report. Scenes that were combined and the resultant quality of the combined data are given below:

SCENE	DATE	QUALITY
1048-15434	9/9/72	hazy, cloudless, poor
1066-15434	9/27/72	hazy, scattered clouds, fair
1067-15492	9/28/72	hazy, clouds, fair
1084-15440	10/15/72	clear, cloudless, good
1085-15494	10/16/72	hazy, clouds, fair
1102-15442	11/2/72	hazy, scattered clouds, poor
1157-15500	12/27/72	dark images, poor color saturation
1174-15440	1/13/73	large high cumulus clouds with dark shadows, poor dense color
1175-15495	1/14/73	cloudless, dense positives resulted in dense poor color saturation

A comparison between the quality of Goddard bulk color composites and I^2S combined 70 mm bulk products shows that despite serious variations in color saturation and density, the Goddard composites are of superior resolution.

2. Over 90 random points were used to check the geometric fidelity of both precision and bulk 9.5- x 9.5-inch data products. These points were located within a rectangle formed by thirty-minuty geographic plane coordinate intersections--longitude 84°00'W, 84°30'W and latitude 33°00'N, 33°30'N. The points were transferred from 1:120,000 scale color infrared transparencies (dated October 2, 1972) to a 1:250,000 topographic sheet for Atlanta using a Bausch and Lomb Zoom Transfer Scope (ZTS). An overlay of the point locations made on stable base material was copied photographically to a 1:1,000,000 scale. Then a transparent film template was printed to attach to the ERTS 1:1,000,000 scale image. This template included 15-minute plane coordinate intersections, 50,000-meter UTM grid

intersections, and major features. The template was matched with both the precision image 1084-15440-5 and bulk composite 1102-15442-4, 5, 7. Each ERTS image, with template attached, was mounted on the ZTS illuminator. Then the 1:120,000 scale CIR photo transparencies were oriented with the respective ERTS image on the ZTS mapping surface. The distance between the actual image locations scribed on the photographs and the location of the points on the ERTS images were measured. The results are shown below:

SCENE	DATA TYPE	NUMBER SAMPLES	GEOMETRIC ERRORS (millimeters) Mean	Range	MEAN GROUND ERROR (meters)
1084-15440	Precision	90	0.30	0.15-0.52	300
1102-15442	Bulk color	92	0.52	0.35-0.64	520

Errors were largely systematic. On precision data the true photo position was always north of the ERTS location. On bulk color composites the true photo position was always east of the ERTS location. Considering that the ERTS Manual calls for positional mapping accuracy of only 743 meters on bulk products and 242 meters on precision products, the errors seem rather close to the predicted.

3. A field trip to the Atlanta site which was scheduled for April was called off when the RB-57 aircraft support flight was cancelled by NASA/Houston.

4. Work on unsupervised clustering and supervised classification procedures continued. This work proceeds very slowly due to a shortage of computer programmers.

WORK PLANNED FOR NEXT REPORTING PERIOD:

1. A three-man crew will spend two weeks in the Atlanta test site gathering ground truth in conjunction with an RB-57 aircraft support flight scheduled for late May.

2. Because of poor positional accuracy, poor color quality, and, above all, poor coverage of the test site, we will prepare an amendment to our Data Analysis Plan to take better advantage of the data we have.

3. New ERTS imagery will be examined and evaluated as it is received.

4. Work will continue on both unsupervised clustering and supervised classification procedures for automated land use classification using ERTS MSS digital data.

SIGNIFICANT RESULTS: The positional accuracy of a large number of random points was checked on both precision black-and-white and bulk color composites. The errors were systematic, and the ground locations were found to be, on the average, 300 meters south of their true position on precision data and 520 meters west of their true position on the bulk data.

PUBLICATIONS: None

RECOMMENDATIONS FOR CHANGES: A revised data analysis plan will be written to make better use of the data quality and devices at our disposal.

STANDING ORDER FORM CHANGES: None

ERTS IMAGE DESCRIPTOR FORMS: None

DATA REQUEST FORM CHANGES: None

TITLE: Inventory of Forest and Rangeland and Detection of Forest Stress

ERTS Proposal Number 226

Manitou Test Site (Rangeland Inventory) 226C

Coinvestigator; Richard S. Driscoll

GSFC Identification Number AG-014

Principal Investigator - Robert C. Heller

STATEMENT OF PROBLEMS:

1. Major surgery (spinal fusion) of the coinvestigator and a serious internal viral infection of his colleague impeded progress on the rangeland inventory portion of the investigation during this reporting period. Health has returned so future progress will be significant.

2. Retrospectively ordered products of Observation ID 1028-17135 have just begun to arrive. This is the one best scene obtained of our test site during the 1972 growing season and the one upon which our primary analyses will be conducted.

ACCOMPLISHMENTS DURING THE REPORTING PERIOD:

1. Preliminary analysis of data collected at our intensive study site, Manitou Experimental Forest proper, indicates that dry weight of standing crop biomass in some grasslands may be estimated by determining the relationship between foliar cover and standing crop. In this case, foliar cover was determined by point sampling a series of small plots imaged in extremely large-scale stereo photographs. Standing crop biomass was determined by removing above-ground herbage from the same ground plots after the photography was secured. Using standing crop as the dependent variable and foliar cover as the independent variable, regression values (r) were in excess of 0.90 for some individual plant species. These data now need to be pooled to develop the relationship for the total grassland community. The information, together with spectral measurements we have made of the same community parameters, forms the base data for our multiple sampling procedures for analyzing the ERTS data.

2. Templates have been completed identifying UTM positional coordinates of plant community systems and land uses to be sampled in the ERTS imagery. Testing for visual and microdensitometer interpretation of

these land classes has been started using the ERTS photographic products just received. We do not have sufficient data to make any statements as yet. Geometric fidelity for positional accuracy of data positions in the digital CCT's has not yet been determined.

3. The location of training and testing data sets for the established plant community and land classes have been nearly all transferred to our ERAP data from Missions 205 and 211. Image descriptors to subsequently be used for visual interpretation of the ERTS supporting ERAP data are nearly complete.

4. Arrangements were made with the NASA/Houston Data Management Section to provide us 7-track CCT's of the ERAP C-130 Mission 213 data. We plan to process these data in June, or as soon as they are received.

WORK PLANNED FOR NEXT REPORTING PERIOD:

1. Determine the positional accuracy and the radiometric fidelity of precision processed products, both photographic and CCT's of scene I. D. 1028-17135 in relation to recognition analyses for plant communities and land uses.

2. Initiate analysis of the bulk processed CCT's of scene I. D. 1028-17135. This will include both supervised and unsupervised clustering techniques.

3. Two men will spend approximately two weeks in the field validating the location and description of some grassland communities.

4. Proceed with data analysis by completing image descriptors for ERAP and ERTS photographic products for continuing human and microdensitometric interpretation.

5. We hope to complete our analysis of the relationship between optical film image density, ground-measured spectral radiance, and estimated plant community parameters to establish a base for a multiple sampling procedure using ERTS and ERAP products of our intensive study site.

SIGNIFICANT RESULTS: None

PUBLICATIONS: None

RECOMMENDATIONS FOR CHANGES: Send all ERTS products of the Manitou site (226C) initially to the coinvestigator - Richard S. Driscoll.

STANDING ORDER FORM CHANGES: See Robert C. Heller's letter dated April 18, 1973, to S. Provenzano.

ERTS IMAGE DESCRIPTOR FORMS: 6 submitted

DATA REQUEST FORM CHANGES: None at present